

Functionally Graded Polyimide Nanocomposite Foams for Ablative and Inflatable/Flexible/Deplorable Structures, Phase I

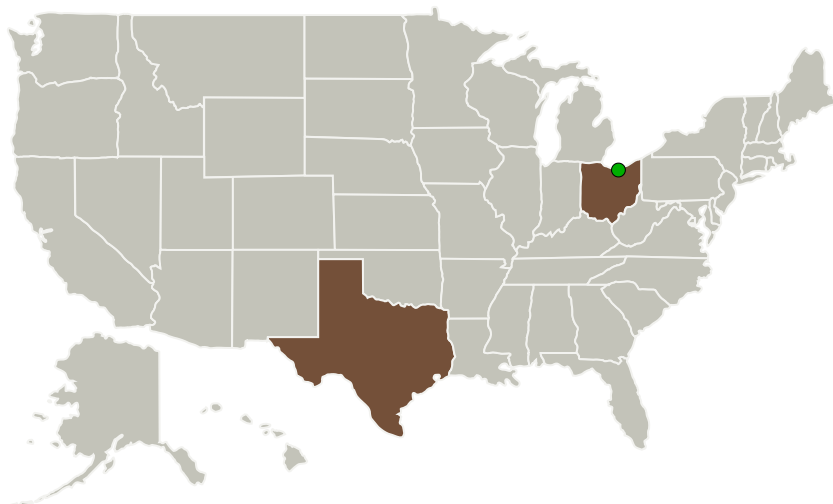
Completed Technology Project (2012 - 2012)



Project Introduction

The objective of the proposed research is to develop functionally graded polyimide foams as light-weight, high performance thermal protection systems (TPS) for ablative and inflatable/flexible/deplorable structures used in space exploration missions. In the first phase of this project, we will demonstrate the feasibility of fabricating graded polyimide micro/nanocellular foam structures and characterize their insulation and ablative properties. We propose to fabricate graded polyimide foams with density gradient that are similar to those of functionally graded PMMA foams produced at UT Austin recently, using melt processable thermoplastic polyimide films by a solid-state foaming process with supercritical CO₂. Gradient polyimide foam structures with tuned thermal protection properties are unique and not available until now. The advantage of this innovative approach is two folds: 1)Functionally graded, non-homogeneous polyimide foams that allows continuous variation in macroscopic mechanical and physical properties, to tune the thermal conductivity, specific heat, density, and ablative behavior. 2)The use of melt processable polyimides and the solid-state supercritical CO₂ foaming process eliminates the needs of using high boiling solvents, and the costly, tedious solvent exchange process, which is required during the making of porous aerogels from solutions. Open-celled polyimide foams with large visible uniform pore sizes have been produced commercially, however, graded porous polyimide thin films with density gradient, open or close celled, are rare and pose more technical challenges, but can provide additional unique benefits.

Primary U.S. Work Locations and Key Partners



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Organizations Performing Work	Role	Type	Location
Koo & Associates International(KAI)	Lead Organization	Industry Women-Owned Small Business (WOSB)	Austin, Texas
● Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio

Primary U.S. Work Locations

Ohio	Texas
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Project Transitions

▶ **February 2012:** Project Start

✓ **August 2012:** Closed out

Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/138179>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Koo & Associates International (KAI)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

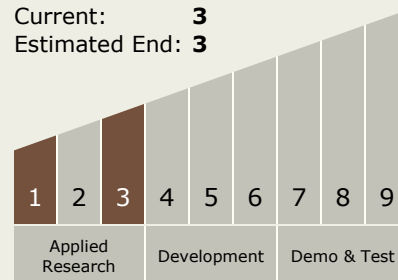
Program Manager:

Carlos Torrez

Principal Investigator:

Joseph H Koo

Technology Maturity (TRL)

Start: **1**Current: **3**Estimated End: **3**

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Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
 - └ TX12.1 Materials
 - └ TX12.1.1 Lightweight Structural Materials

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System